INTERESTING PROBLEMS CONNECTED WITH THE CHECKERED WHITE BUTTERFLY PIERIS PROTODICE, BOISDUVAL AND LECONTE.

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Although the life history, habits and peculiarities of many of our common North American butterflies are fairly well known, there are certain phases of the life of the so-called Checkered White Butterfly—*Pieris protodice*—that still remain a mystery.

This insect is sexually dimorphic, i.e., the sexes show marked differences of coloration and wing pattern, although the ground color of both sexes is white. In the male the upper surface of the hind wings is devoid of spots or other markings, but there are numerous black spots and streaks on the upper surface of the primaries or fore wings. The females are more heavily marked with larger spots, producing a checkered effect. It is this distinctive marking which gives the name, Checkered White, to the species. In addition to being sexually dimorphic, *protodice* varies in coloration with each succeeding generation. The first brood, which appears early in the spring, is quite heavily marked with greenish or greenish-gray bands along each side of the veins on the under surface of the hind wings in both sexes and is known as *vernalis*. The next generation loses a great deal of this coloration and in the summer brood the markings on the under surface of the hind wings of the males may be entirely lacking. In the late fall brood the coloration has a tendency to revert to the early spring form, but the coloration is never quite as dark.

Protodice is a native species with a range extending over most of North America. It is found from the Atlantic Ocean to the Rocky Mountains and from Southern Canada to Texas. Although it is considered to be more or less common over most of its range, several authorities are of the opinion that it is less common than formerly and the theory has been advanced that the Garden or Cabbage Butterfly, *Pieris rapae,* has in some way affected its normal abundance. If the Cabbage Butterfly has had this effect it may possibly be due to the simultaneous introduction of harmful parasites, for it is well known that many parasites, that have had time to adapt themselves to different hosts, have developed a balanced host-parasite relationship, a condition where both the parasite and its host have attained a biological balance or tolerance towards each other, so that, in most instances, there is no resultant damage. As a matter of fact good or well adapted parasites rarely cause any

appreciable harm to their hosts, for by so doing they would destroy, or at least limit, the source of their existence. It must, however, be borne in mind that considerable time, possibly hundreds of years, is necessary to develop such a balance or tolerance. As a usual thing when a parasite transfers itself to a new host considerable damage may result, and it is, therefore, quite possible that the parasites introduced with the Cabbage Butterfly may have attacked *protodice,* which not having had time to develop this balance or tolerance may have been harmed sufficiently to account for the reputed reduction of its former numbers. Definite proof is, of course, necessary to support this theory.

Furthermore, *protodice,* like a number of other species of butterflies is subject to seasonal fluctuation in numbers. The reason for these fluctuations or irregularities is not well understood. During 1943, the specimen taken by one of our local collectors, namely Mr. Ralph Beebe of Ecorse, Michigan, is the only one of which I have any definite record. The writer's field notes (started in 1931) afford evidence of this seasonal fluctuation. In 1937 it was very common and during the latter part of 1940 and 1942 it was comparatively numerous. The unfavorable, wet spring that prevailed in this section of Michigan in 1943, may have been responsible for the local scarcity of the species and this circumstance is intimately connected with one of the problems given consideration in this article, namely: the survival of a species that has become reduced to a low status of abundance due to various causes. Let us, at this time, consider the life history of *protodice.* This species normally hibernates in the pupal stage, attached to weed stalks or other objects, in the characteristic position of the Pieris family—with the end of the tail firmly embedded in a button of silk and supported in a more or less horizontal position by a girdle of silk around the upper part of the body. In southern Michigan, the first generation hatches around the middle or latter part of April. The eggs develop into larvae which are alternately striped with golden yellow and greenish purple on the upper surface. The under surface is light green in color and there are a number of black dots on the body. The larvae feed on cabbage, turnip, mustard, and other Cruciferous plants and when full-grown change into light bluish-gray pupae. The *vernalis* form of *protodice* emerges around the middle or latter part of April dependent on the weather and as previously described, this generation is distinctly marked and is not easily confused with any other brood of *protodice.*

The spring form, *vernalis,* is, usually, not very abundant, at least

not nearly so common as forms which occur later in the summer. The question now arises: In cases where *vernalis* becomes so rare, that its survival becomes extremely precarious, how does the species survive in localities where these influences prevail? It must be remembered that the early spring form, *vernalis,* is the foundation stock from which succeeding broods are produced. In other words, if the foundation or parent stock fails, how does the species continue to carry on? There are two theoretical explanations which seem logical—either the normal abundance of *protodice* is built up from survivors of the spring brood or the balance of numbers may be restored by the influx of migratory stock from outside the depleted territory. This question cannot be answered satisfactorily until we know more about the normal range of the flight of *protodice* but it would be interesting to take careful notes of the relative abundance of the various broods as they occur from year to year. Such observations may furnish clues to the method by which the normal balance in number is restored. The problems concerning migratory movements might be solved much sooner if only there were more trained observers available, since methods have now been devised to mark insects in a manner similar to the way in which birds are marked.

There are many other questions concerning *protodice* which are of interest to the lepidopterist. For instance, on October 8, 1939, the author, in company with Mr. Sherman Moore of Detroit, took about one dozen specimens on the Edwin S. George Reserve, near Pinckney, Livingston County, Michigan, that were so unusually marked as to cause considerable confusion as to their status. These specimens resembled the Western *Pieris occidentalis* very closely. By way of explanation, *occidentalis* is listed by Dr. J. McDunnough in his 1938 check list of "The Lepidoptera of Canada and the U. S. of America" as a distinct species. A careful examination of a series of typical *occidentalis,* from California and other Western states, shows that this race is very similar to the late fall specimens of *protodice* taken by Mr. Moore and the author on the George Reserve. For this reason they could be and probably are easily confused. There are, however, slight yet constant differences that enable a critical observer to separate the late fall brood of *protodice* from the western *occidentalis.* For instance, in typical male *occidentalis,* the triangular markings at the end of the veins at the edge of the outer margin on the upper surface of the fore wings are broader and more elongated and the apex in many specimens extends a little further toward the base of the wings than in

protodice. Furthermore, the marginal row of spots running more or less parallel with the outer border of the primaries has a tendency to run together forming a bar in *occidentalis,* but rarely, if ever, in *protodice.* The under surface of the secondaries or hind wings, in either males or females does not differ to any appreciable extent in either typical *occidentalis,* or well marked specimens of the late fall brood of *protodice.* Nevertheless the coloration on the under surface of *occidentalis* is generally greener, and somewhat darker in shade than the average coloration seen in fall *protodice.* The reverse may be true in an occasional specimen. It is also advisable to note that the late form of *protodice* has been taken in other states than Michigan. The author's collection contains several well marked specimens from the District of Columbia and also one or two lighter marked specimens from Kansas. There seems to be no definite information available as to the range of this form of *protodice,* in fact, very few lepidopterists seem to have mentioned it.

Typical *protodice* occurs in the same territory as *occidentalis,* but the reverse is not true, that is, *occidentalis* is not found all over the territory where *protodice* ranges. In this connection, it should be noted that the status of *occidentalis* is controversial, a number of authorities are of the opinion that it is not a good species but is a western race of *protodice.* Dr. John A. Comstock in his book entitled "The Butterflies of California" regards *occidentalis* as a Western high altitude form of *protodice.* Most of the more recent writers hold the same opinion as Dr. Comstock. It might be well to mention here that the form *calyce* is considered to be a spring form of *occidentalis.* It, apparently, bears the same relationship to *occidentalis* as *vernalis* does to *protodice.* The markings on the upper surface of both wings are much heavier in *calyce* than in *vernalis,* in fact they can be very easily separated by any one who is familiar with the various forms and races of *protodice.*

There are other interesting facts concerning the late fall form of *protodice.* It occurs about the first week in October, providing weather conditions are favorable. This is of importance since rather severe frosts sometimes occur during the first week of October, and it is apparent that, at this time, it is too late in the season for the late broods of *protodice* to reproduce, other than by laying eggs, and this procedure is, to say the least, very questionable. As far as is known, there has been no report of *protodice* laying eggs in the late fall. It is generally believed that the species normally passes the winter in the pupal stage. Therefore, the question is: What happens to the last or late brood? Are they

killed by the frosts which occur so frequently in this state during the month of October? In other words, do they die, as the lawyers say "without issue"? As we have no knowledge that *protodice* hibernates in the imago stage, it may be assumed that this late generation actually dies without leaving descendants. Possibly this is an example of a species over-reaching its capacity for normal or successful reproduction because of the lateness of the season. Information is lacking as to whether the late fall occidentaloid form occurs every year or whether it does so only when weather conditions are suitable. Perhaps the last generation, already in the pupal stage, which would ordinarily hibernate, may be induced to hatch because of ideal weather conditions, only to meet its fate because of insufficient time to produce another generation. If the pupae of the last generation prematurely hatch because of favorable weather, what becomes of the early spring generation that normally occurs in April? Possibly a sufficient number of the pupae do not hatch prematurely but are carried through the winter and hatch in the spring as they normally should. The unseasonable hatching of pupae in the fall may be an explanation as to why the early spring form, *vernalis,* is relatively uncommon, although this is probably only one of a number of reasons.

The last problem but not necessarily the least is how many broods or generations does *protodice* have in this State? Dr. J. H. Comstock in "How to Know the Butterflies" states that it is triple brooded. Macy and Shepard in "Butterflies North of the Potomac and Ohio Rivers and East of the Dakotas" state, "In the latitude of Minnesota the spring form appears in April and early May. The second generation in July and the third in September." William Field in "The Manual of Butterflies of Kansas" states that *protodice* has two forms, one in spring, another in summer, and that in October a form occurs intermediate between the spring and summer forms. This latter undoubtedly refers to the late fall form which the writer has previously mentioned. Mr. Austin H. Clark in "Butterflies of the District of Columbia" mentions three broods, the first in late April up to the first half of June and the second in July. This flies until the advent of the third brood towards the end of August. It would therefore appear to these authors that *protodice* normally has three broods during the season.

This paper may seem rather involved, but it is hoped that it will help to stimulate greater interest in problems that need to be solved and it also emphasizes the fact that there is a great deal more to the study of insects than the mere acquisitive act of making a collection.

In conclusion, a summary of the main principles of this article may bring them out in somewhat clearer detail.

1. The Checkered White Butterfly, *Pieris protodice,* is both sexually and seasonably dimorphic.

2. It is reputed to be less common than formerly, and one of the reasons for this is that the Common Cabbage Butterfly, *Pieris rapae,* is supposed to have interfered with its normal prevalence. Probably parasitism is one of the most likely explanations.

3. Like many other species of butterflies *protodice* fluctuates in abundance from season to season.

4. A theory is presented to explain the survival of the species when at a low ebb, possibly by the influx of migrants into depleted territory.

5. A late fall form of *protodice* is described that resembles the western form or race, *occidentalis.* This late fall form is considered by the author to be different from typical *occidentalis* and that the latter is not recognized, at least by some authorities as a separate species but as a western race of *protodice.*

6. Problems about the survival of the occidentaloid form of *protodice* are discussed in the belief that this particular form is one which hatches from pupae prematurely because of favorable weather only to be killed "without issue" by the early frosts.

7. The question is asked, "How many broods does *protodice* have in the State of Michigan?" We know too little about this and more definite information is greatly desired.

8. Hope is expressed that this article will create sufficient interest so that others will be stimulated in making further observations that will answer these questions.

A Mixed up Butterfly.—I have in my collection of Oregon butterflies a specimen of *Euphydryas colon* Edws. that might almost be called an aberrant aberration. The white spotting of the forewings on both the upper and under sides are elongated through their interspaces. These represent albifusism and the so-called transition form *fenderi* Gund. The white spotting on the upper sides of the hind wings is almost obliterated by the black areas. These represent melanifusism and the so-called transition form *mcdunnoughi* Gund. This specimen was collected at Elk Lake, Santiam Nat. Forest, Oregon, July 8, 1939, by Mrs. D. M. Fender. If such a freak is deserving of a name, I herewith propose the name of *Euphydryas colon* ab. **bakeri** after Mr. Jim Baker of Baker, Oregon.—Kenneth Fender, McMinnville, Oregon.